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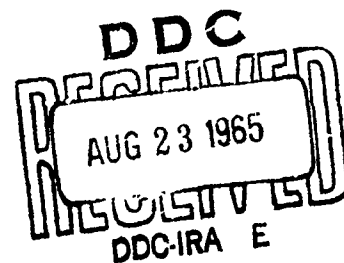
STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY
RELATING TO STRENGTH AND ENDURANCE

PHASE VI

THE MUSCULOSKELETAL ANATOMY OF THE THORAX AND BRACHIUM OF A
SQUIRREL MONKEY (SAIMIRI)

William E. Edwards
Erika Fogg-Amed

July, 1965



6571st Aeromedical Research Laboratory
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FOREWORD

This study was conducted by William E. Edwards under Contract AF 29(600)-3466, Project 6892, Task 689201 from 1961 - 1963. The program was monitored by Major James E. Cook, Veterinary Services Division, ARV.

This is the sixth in a series of nine papers being prepared under Contract AF 29(600)-3466 on the Study of the Monkey, Ape and Human Morphology and Physiology Relating to Strength and Endurance and the third of four papers concerned with the musculoskeletal system of the thorax and upper extremities of the chimpanzee and the squirrel monkey.

The very helpful cooperation of Lt Col Hamilton H. Blackshear, Major James E. Cook, Major Clyde H. Kratochvil and Major Robert H. Edwards, all of the 6571st Aeromedical Research Laboratory is gratefully acknowledged.

Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.


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ABSTRACT

The thoracic and brachial musculature of a female squirrel monkey (Saimiri) is described and illustrated by the photo-etching process. Comparisons with data from the literature on other platyrrhines and a few non-platyrrhine forms are provided.

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1. INTRODUCTION

The history of primate anatomy has been summarized in a previous paper on the musculoskeletal anatomy of the thorax and brachium of an adult female chimpanzee (Edwards, 1965a).

The squirrel monkey (Saimiri) has some special significance derived from its ready availability for laboratory studies, for it is quite possibly the most abundant non-human primate (Hill, 1960, pp. 293 and 304; Sanderson, 1957, p. 76). Its usefulness in laboratory studies is augmented by its shy but tractable, non-vicious nature -- although among the higher primates it is not notably intelligent, and its delicate nature and high rate of activity somewhat decrease its usefulness for some laboratory research.

The significance of the squirrel monkey to primatological studies is also enhanced by its very generalized nature relative to the majority of primates, as indicated by its primitive anatomical traits. This primitivity (conservativeness) tends to be confirmed by its close similarity to Neosaimiri fieldsi from the La Venta fauna, apparently Late Miocene in age, of Colombia's Magdalena basin (Hill, 1960, pp. 320-322), for primates apparently did not enter South America until shortly before, during the Early Miocene (Edwards, 1961). The generalized nature of Saimiri is also reflected in its classification -- without any consistent assignment of affiliation with any other platyrrhine (see, for example, Hill, 1960, pp. 250-251).

Despite its availability and significance, Saimiri has been studied very little and with no published anatomical study of its thorax and pectoral limb. In fact, among the platyrrhines only the marmoset Hapale jacchus and the primitive, monkey-like Callimico goeldii have been at all adequately studied in respect to their total musculature (Hill, 1957, p. 91; Hill, 1959).

2. HISTORY OF THE RESEARCH

A moderately detailed history of the multiple project of which the current study constitutes a part was reported in the first of this series of papers (Edwards, 1965a).

Here it will be noted briefly that the subject died at the Aeromedical Research Laboratory on July 17, 1961. Death was apparently the result of dehydration; avoidance of dehydration is especially difficult with these monkeys (Hill, 1960, p. 295), in part because of their small volume-to-surface-area ratios and the requirements resulting from geometrical similitude (Edwards, 1963b).

Dissection was initiated as an extra-time project by the senior author immediately upon autopsy the day after death because of the author's interest in the muscular functioning of these and other primates.

After intermittent study during the following two months, work was discontinued until the spring of 1963, when it was resumed under an Aero-medical Research Laboratory contract.

3. PROCEDURE OF STUDY

Dissection was performed primarily on this subject's right side, to which all drawings refer. For consistency and ease of comparisons with drawings, all descriptions and all measurements in the text also refer to the right side.

The photo-etching process -- described in Edwards, 1965a, and, for the last four figures, modified as described in Edwards, 1965c -- was employed for the high accuracy obtainable, with pencil and India ink drawings made directly on photographs which were subsequently bleached out.

All photographs were prepared and some were taken by the senior author, while the remainder were taken by Mr. Robert Halferty of Land Air, Inc. The assistant author drew Figures 9-12; the remainder were drawn by the senior author -- mostly as the first drawings in the series of four anatomical papers, before techniques of representation were refined. The text of this report was prepared by the senior author.

4. DESCRIPTION OF SUBJECT

The subject of the following anatomical study is an adult (apparently young) female squirrel monkey (Saimiri). Data for proper identification were not available at the time of autopsy, but photographs and notes may indicate the specific designation of sciurea (Hill, 1960).

The subject weighed 535 gm. at death, but an estimated dehydration weight loss of 4-5 per cent, apparently causing death, indicates a normal weight of some 560 gm. The brain weight (after dehydration) was 20.0 gm. The following measurements were made before removal of any dermis or flesh.

All measurements
in millimeters

- | | |
|---|-----|
| (1) Nasion to tip of fleshy tail, along dorsal surface (hair extends 23 mm. beyond) | 692 |
| (2) Nasion to base of tail, along dorsal surface | 297 |

(3) Nasion-gnathion height	29.5
(4) Maximum bi-zygomatic diameter	34.0
(5) Maximum circumference of head (across supraorbital ridges and occiput)	148
(6) Interacromial diameter	43
(7) Acromion tip to olecranon tip, diameter	75.5
(8) Maximum length of humerus (measured from radiograph)	68.0
(9) Maximum length of ulna (measured from radiograph)	71.2
(10) Maximum length of radius (measured from radiograph)	66.1
(11) Mid-dorsal point on proximal margin of wrist to distal fleshy tip of hand (digit III)	50.5
(12) Chest girth immediately posterior to axillae	145
(13) Waist girth (20 mm. anterior to anterior border of lower extremity)	116
(14) Maximum breadth of body in pelvic area	45
(15) Mid-point of dorsal surface over sacrum to mid-point of anterior surface of knee, diameter (normal flexion)	98
(16) Mid-point of anterior surface of knee to mid-point of plantar surface of heel, diameter	98
(17) Posterior margin of heel to distal fleshy tip of foot (digit IV)	80

5. DESCRIPTION OF MUSCLE MORPHOLOGY

A. Muscles of the Shoulder Girdle

Pectoralis major. This large, flat muscle is the most superficial one of the chest, except where covered by platysma (which in this specimen was quite well developed) in its most cephalad portion (Figs. 4-6 and 10). It apparently does not manifest any clavicular origin but only a sternal one, although damage to the median portion of the rib-cage area upon autopsy before the present study was initiated necessitates some uncertainty on this point. From its rather broad and fan-shaped origin,

the muscle fascicles converge as they approach the humerus to form a folded muscle at the insertion. The fleshy portion of the muscle almost reaches the humerus superficially, as is the case deeply at the proximal and distal ends of the insertion, but between these borders the tendon of insertion extends medially 10 mm. to form a triangular tendinous area (Figs. 5, 6, and 10). The area of insertion is an extremely long, almost straight line approximately 1 mm. wide and 22.5 mm. long, from only 2 mm. below the proximal tip of the humeral head down the mid-line of the anterior aspect of the humerus,¹ across the greater tuberosity, along the lateral tip of the bicipital groove, and along the medial border of the area of insertion of deltoid, which along that border attaches to this tendon of pectoralis major. The insertion extends fully 36 per cent of the distance to the distal end of the 68-mm. humerus.

In another platyrrhine which may represent one of the closest extant relatives of Saimiri, the capuchin monkey (Cebus), the sternal origin of pectoralis major extends to the ninth rib (Hill, 1960, p. 348). Another platyrrhine, Callimico goeldi, will also be employed for comparative purposes in this paper because it is apparently even more primitive than Cebus and because it is anatomically one of the most thoroughly studied of all primates. In Callimico, the muscle origin is from the sternum distally to the seventh costal cartilage, while the insertion is mainly fleshy and, although located similarly to that of Saimiri, is only 12.7 mm. long on the 54.5-mm. humerus (Hill, 1959, pp. 28 and 49).

Pectoralis minor. Flat and approximately triangular, this muscle traverses much of the cephalad portion of the rib-cage obliquely and deeply to the much larger pectoralis major; although damaged before its study, it apparently extended superficial to the long coracoid process to insert broadly (10 mm.) and tendinously over the tendon of the long head of biceps into the shoulder-joint capsule, primarily into the medial portion of the cephalad aspect of the capsule (Figs. 4-6).

In Cebus, pectoralis minor inserts on the greater tuberosity of the humerus, or into the shoulder-joint capsule, or apparently upon the coracoid process with a coraco-humeral ligament extending the line of insertion to the greater tuberosity (Hill, 1960, p. 348). This muscle in the only intensively studied specimen of Callimico was quite similar to that in the present squirrel monkey subject, with insertion into the shoulder-joint capsule, but "fleshy throughout" (Hill, 1959, p. 49). Marmosets also generally manifest the capsular insertion (Hill, 1957, p. 147).

¹Its comparable position in man is between the ventral and lateral aspects of the humerus, because of the outward relation of the shoulder and upper extremities in man.

It may also be observed that in man insertion of pectoralis minor is usually upon the tip of the coracoid process of the scapula, but commonly it extends (as part of the coraco-humeral ligament) to the greater tuberosity of the humerus, and "in about 15% of limbs . . . part of the tendon of the Minor passes over the coracoid process . . . to re-inforce the coraco-humeral ligament" (Grant, 1947, pp. 14 and 18).

Trapezius. This broad muscle, bilaterally of trapezium outline, the most superficial of the skeletal muscles where it occurs,² extends over almost half (mostly the cephalad half) of the dorsal surface of the thorax, but it is relatively thin. Its extensive origin along the cervical and thoracic portions of the mid-line of the back and its convergence of fascicles to broad but more limited insertion on the spine of the scapula, the acromion, and the clavicle are in general similar to those of the human trapezius. But the caudal portion inserts more medially upon the spine of the scapula -- along the posterolateral aspect from the spine's posteromedial tip to the posteromedial end of the strip of origin of deltoid 11 mm. from the vertebral margin of the scapula. Also, the middle portion does not pass superficial to the medial portion of the scapular spine but inserts upon the anteromedial aspect of this spine from the spine's posteromedial tip almost to the tip of the acromion, thus largely accounting for the marked differences in fascicle alignment, especially in the middle portion, compared with man (Figs. 1-2). Anteriorly, this muscle is attached to an area 7 mm. long on the deep surface of the clavicle, 3 to 8 mm. medially from the acromio-clavicular joint and extending at that more medial point 2 mm. farther to the base of the coracoid process, which is a bony projection fairly uniformly some 2.5 mm. wide and 9 mm. long.

Where trapezius approaches latissimus dorsi in a zone extending cephalad and laterally from the vertebrae across the posterior angle of the scapula, the intermediate zone is composed of much thinner tissue than the muscles anterior or posterior; although largely fascia, a thin layer of muscular tissue also covers this zone, which is more typically aponeurotic near the vertebral column.

In Cebus, trapezius is very similar to that of the present specimen; in one species, there is an attachment to the clavicle, but not in another (Hill, 1960, p. 347). Trapezius does not extend to the occiput in Callimico (unlike the muscle in at least some marmosets); the general form of the muscle is similar to that of Saimiri, but not the fascicle alignment or the fusion with latissimus dorsi (Hill, 1959, p. 48). "The muscle is not present in Strepsirhini!" (Hill, 1955, p. 38).

²Superficial to the scapula and the surrounding area is noted an immediately subdermal sheath of striated muscle which adheres to the dermis when the latter is pulled away from the underlying structures.

the latter by thin fascia, and fuses to it shortly before its insertion, but the four anterior slips fuse to insert upon a partially distinct 6-mm.-long extension -- at and anterolateral to the anterior angle of the scapula -- beyond the 21.5-mm.-long insertion of serratus ventralis. Along the anterior (cephalad) two-thirds of its insertion, serratus ventralis proper is attached to rhomboideus by means of an intervening tendinous sheath. The combined serratus ventralis (with levator scapulae at the cephalad end) and rhomboideus attachment, with that of rhomboideus superficial to the others, constitutes a strip fairly equally split between the two major muscles and extending the entire length of the vertebral border of the scapula; the total width of the combined attachment is less than 3.0 mm. near the anterior end and gradually diminishes to 1.5 mm. as the posterior angle of the scapula is approached.

These muscles are apparently fairly similar in Cebus (Hill, 1960, p. 342) and in Callimico (Hill, 1959, p. 49).

Atlanto-scapulares. The origins of this pair of muscles (the dorsal one of which has also been termed levator scapulae spinatus) are from the dorsal and ventral aspects of the transverse process of the atlas. Although this area of origin was removed before the present study, the muscle inserting upon a narrow strip of the entire length of the anteromedial aspect of the scapular spine -- from 2.5 to 16 mm. posteromedial from the tip of the acromion, immediately beneath the insertion of trapezius along a subjacent strip -- seems to represent the dorsal member of this pair.

In the haplorhines, the dorsal member of this pair of muscles typically "inserts on the cranial border of the lateral half of the spine and acromion process of the scapula" (Hill, 1955, p. 37). "In the monkeys generally the muscle lies beneath the trapezius and extends to the tip of the acromion. The muscle of the brachiators has migrated from the scapula to the clavicle," and has thus been converted to the homologous omocervicalis (Miller, 1932, p. 9).

B. Muscles of the Shoulder

Deltoideus. This broad, triangular muscle covering the shoulder area consists of three distinct segments: cleido-deltoideus, acromio-deltoideus, and spino-deltoideus (Figs. 1, 2, 4, and 9). The posteromedial end of its partial origin in a narrow strip along the posterolateral aspect of the scapular spine is 11 mm. from the vertebral border of the scapula, measured along the spine of the scapula. From the very extensive areas of origin, the fibers of the three segments converge -- ventrally overlapping a portion of pectoralis major as the first segment converges -- to an apex on the anterolateral aspect of the proximal portion of the humerus, with insertion covering an area of approximately 110 degrees, from 10.5 to fully 29 mm. below the proximal tip of the humerus.

The deltoids of Cebus (Hill, 1960, p. 33) and of Callimico (Hill, 1959, pp. 49-50) are apparently very similar to that of Saimiri.

Supraspinatus. This muscle, the sole occupant of the deep (5 mm.), V-shaped supraspinous fossa (27 by 8 mm.), from the posteromedial six-tenths of which it arises, underlies much of the more lateral portion of trapezius (Fig. 9). Relatively narrower and thus more elongated than in the largest primates, its fibers converge somewhat as it extends laterally beneath the acromion to insert into the shoulder-capsule over an area approximately 4.5 by 4.0 mm. almost precisely at the center of the top (proximal) surface of the humerus.

In Callimico, supraspinatus is quite similar (Hill, 1959, p. 50).

Infraspinatus. This muscle, much larger than supraspinatus, arises thinly from much of the surface of the infraspinous fossa which it occupies; after developing greater thickness toward the shoulder, its fibers converge to insert fairly narrowly (and mostly fleshily almost to the bone) upon the upper portion of the posterior margin of the greater tuberosity of the humerus, over an almost round area 3.5 by 3.5 mm. on the lateral aspect of the humerus, just lateral and distal to the insertion of supraspinatus and 2.5 to 6.0 mm. below the top of the humerus (Figs. 1, 2, and 9).

The muscle is apparently fairly similar in general form in Callimico, but in this primitive platyrrhine it is "incompletely differentiated from the teres minor" (Hill, 1959, p. 50).

Teres minor. Fairly well conforming to its name ("small round"), this muscle arises moderately broadly from the shoulderward half of the dorsolateral aspect of the axillary border of the scapula, over an area 5.5 mm. long and 1.0 mm. wide, 16.5 to 22 mm. from the anterolateral tip of the acromion, or roughly 7 to 13 mm. from the glenoid fossa (Figs. 2 and 9). The fascicles converge somewhat to an almost cylindrical form before inserting quite fleshily a very short distance from their origin upon the posterior aspect of the humerus 6.0 to 9.5 mm. below the top of the humerus. The area of insertion, 3.5 mm. high by 2.0 mm. wide, is on the lowermost facet of the greater tuberosity of the humerus and is immediately distal and posterior to the insertion of infraspinatus.

Teres minor in Cebus (Hill, 1960, p. 348) and Callimico (Hill, 1959, p. 50) is very similar, except that it is apparently much less differentiated from subscapularis than in Saimiri. In Tarsius, "teres minor is sometimes lacking" (Hill, 1955, p. 38).

Teres major. This relatively large and moderately thick muscle -- many times larger than teres minor -- arises from most of the dorsal aspect of the posteromedial half of the axillary border of the scapula, from slightly posterior to the origin of teres minor to the posterior angle, bordered anteromedially by a low ridge of bone on the scapula and broadening in area of origin to 5 mm. near the posterior angle of the scapula (Figs. 2 and 10-12). Separated from teres minor by the long head of triceps, it traverses the lateral wall of the axilla to the middle of

the anterior surface of the humerus, where it inserts 7.5 mm. long and approximately 1 mm. thick 11.0 to 18.5 mm. from the proximal tip of the humerus and immediately anterolateral from the proximal end of the origin of the medial head of triceps; its proximal half is at the same level as the distal half of the insertion of latissimus dorsi, which is lateral to teres major and separated from it by 0.7 mm. (the tendon margins are actually in contact as the tendons spread slightly at their juncture with the bone).

Teres major is presumably quite similar to that of Saimiri in Cebus, in which it is "large in correlation with the additional osseus formation on the axillary border of the scapula -- a feature which Cebus shares with Saimiri" (Hill, 1960, p. 348).

In Callimico it is also "a large muscle of flattened form, becoming thicker toward its insertion" and is otherwise very similar to the muscle in Saimiri as well (Hill, 1959, p. 50).

Subscapularis. Arising across the ventral surface of the scapula, this broad, moderately thick muscle is somewhat multipennate in form (Figs. 4, 5, 11, and 12). It traverses the medial margin of the glenoid fossa to insert quite fleshily adjacent to this fossa in an almost round area 5.5 mm. proximo-distally by 5.0 mm. latero-medially near the top of the anteromedial surface of the lesser tuberosity of the humerus.

The muscle seems quite similar in Callimico to that in the squirrel monkey (Hill, 1959, p. 50).

C. Muscles of the Arm

Biceps brachii. This cross-sectionally ovoid flexor -- the largest of the brachium -- occupies most of the anterior portion of the upper arm, between brachialis laterally and the medial head of triceps medially (Figs. 2 and 4-12). The long head appears to arise from the shoulder-joint capsule at the anterolateral portion of the humeral head, along the medial margin of the greater tuberosity, but in actuality the tendon traverses the humeral head via the narrow but rather deep bicipital groove, deep to much of the capsule, and is seen to arise in an area approximately 2.5 by 2.0 mm. on a slight prominence from the lateral part of the base of the coracoid process, 6.5 to 7 mm. proximal to the tip of the process. The short head takes origin from the entire distal end of the coracoid process, 2.8 mm. broad near its tip (but note the subsequent qualification regarding slips of coracobrachialis), and to a slight extent from the joint capsule more laterally. Slightly distal to the areas of origin the long and short heads, mainly tendinous, are quite slim, 1.3 by 1.1 and 2.0 by 1.6 mm. respectively. The two heads gradually expand distally until they become adherent by moderately thick fascia only some 17 mm. from the origin of the short head. Fairly complete fusion of the fascicles occurs only 3 mm. more distally.

At mid-brachium, the muscle attains maximum dimensions of 9.0 (breadth) and 4.9 mm. (thickness). The fleshy portion of biceps terminates abruptly at the elbow to fuse to a relatively thin (2.2 by 0.9 mm.) and long (6.5 mm. beyond the belly) band of tendon, which on the deep surface is very narrow and lateral to the mid-line of the muscle and extends proximally to a point 16 mm. above the distal end of the belly. The tendon inserts upon the tuberosity of the radius between supinator and the insertion of brachialis.

In Callimico, biceps apparently differs from the present specimen by its "intracapsular long head," the much larger size of the long head (in Saimiri, it is only moderately larger at the point of fusion), the fusion of the heads at the middle of the shaft (instead of between the first and second quarters), and likely its "stout tendon" (Hill, 1959, p. 50).

Coracobrachialis. This muscle is apparently represented on the right side of this specimen only by two small remnants, either individual anomalies or vestigial structures characterizing the genus (Figs. 5-7). The larger (presumed) head arises as a bifurcation of the short head of biceps 13 mm. distal to the tip of the coracoid process. This head extends along the medial surface of the short head of biceps and remains fairly firmly adherent until it terminates 14 mm. more distally along the medial border of the fused biceps, still adherent to biceps only by moderately thick fascia. The maximum diameters of this dimensionally fairly uniform slip are 3.2 by 2.8 mm.

The second muscular (confirmed histologically) slip is 2.8 mm. wide, 0.7 mm. thick, and in excess of 8 mm. long (Figs. 5 and 6). Although fused proximally to the lateral portion of the origin of the short head of biceps on the tip of the coracoid process, it emerges from this origin somewhat deep to the other muscle and almost perpendicular to it; it traverses part of the head of the humerus laterally, immediately superficial to the capsule, and inserts into the capsule at the bicipital groove.

Until more is known of its range and distribution of morphological variation in Saimiri, comparisons of coracobrachialis, which is very highly variable both interspecifically and intraspecifically in other primates, cannot be too meaningful (Howell and Straus, 1931, pp. 17-23; Straus, 1942, p. 294, for a perhaps comparable regressive trend).

Brachialis. Arising from a large portion of the posterolateral surface of the humerus, and located superficially on the opposite side of suspensor radialis (Edwards, 1965d) from biceps, brachialis has a form not unlike biceps and, where it extends along the lateral portion of the shaft of the humerus, some two-thirds as much cross-sectional area (Figs. 2, 4, 5, and 8-12). Its proximal end is moderately (6 mm.) above and posterior to and slightly (2 mm.) above and anterior to the tip of deltoid.

Of likely significance is the occurrence of a fairly separate lateral (distal) head of brachialis. Although it constitutes only approximately one-tenth of the total mass, it occupies a disproportionately larger area of origin on the humerus. The oblique, almost longitudinal plane of separation begins 20 mm. above the distal end of the lateral epicondyle (and almost as high as the proximal tip of brachioradialis) and gradually fades as the segments become more thoroughly fused deeply and distally. The fused distal portion crosses the proximal end of the radius immediately adjacent to and above the insertion of biceps to insert upon the proximal portion of the ulna; however, the more lateral portion of brachialis also has some attachment to the radius.

The partial separation of brachialis into two segments represents a primitive trait among primates, and has previously been reported for Tarsius and Aotes as well as for Saimiri (Howell and Straus, 1931, pp. 23-24).

Dorsoepitrochlearis. With maximum transverse dimensions of 6.7 by 2.8 mm. (14 mm. from its origin), this long, fairly slender muscle arises from the junction of the tendon of insertion of latissimus dorsi and its belly, 11 mm. from the humerus, and extends down the posterior aspect of the brachium to insert upon the medial portion of the olecranon process. The belly extends some five-eighths of the muscle's total length, fusing to tendon at 17 mm. from the insertion.

Comparative data on this climbing muscle, characteristic of all monkeys and apes, reveal nothing especially notable; such comparisons and the evolutionary history of dorsoepitrochlearis have been considered at moderate length in an associated paper (Edwards, 1965a).

Triceps. The long head of this large extensor arises from an area 8 mm. long on the most shoulderward portion of the axillary margin of the scapula, from the scapular margin of the capsular ligament to a point some 7.5 mm. from the glenoid fossa. The lateral head takes origin proximally 9 mm. below the top of the humeral head, as high as and immediately medial to the distal border of the insertion of teres minor, and distally extends some 11 mm. in a narrowing strip down most of the posterolateral border of the insertion of deltoid. The medial head arises from most of the posterior surface of the shaft of the humerus, extending proximally to a point 15 mm. below the top of the humeral head and 5 mm. below the distal end of the origin of the lateral head.

The lateral and long heads fuse slightly above the middle of the humerus. These two heads, combined in their distal six-tenths, become rather firmly adherent to the medial head only just above the insertion. Insertion is of course on the entire proximal aspect of the olecranon except for the small portion occupied by dorsoepitrochlearis, with the tendon of the two combined heads superficial to and extending distally somewhat farther than that of the medial head.

Briefly considered comparative data have failed to reveal any very significant contrasts.

6. CONCLUSIONS

A general discussion of the significance both of function and of musculoskeletal morphology to the phylogenetic history of the thorax and brachium will best be reserved for the concluding section of the companion paper (Edwards, 1965d), after the musculoskeletal system of the antebrachium has been considered.

There will here be noted only the squirrel monkey's marked thinness of many broad muscles, the lesser development of pennateness of certain muscles, and the relatively small amount of tendon as compared with much larger primates, such as the chimpanzee. As will be discussed in the companion paper, the fundamental explanation for these contrasts is the operation of the principles of geometrical similitude on primates of very different body-size.

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APPENDIX

Figures 1 through 12

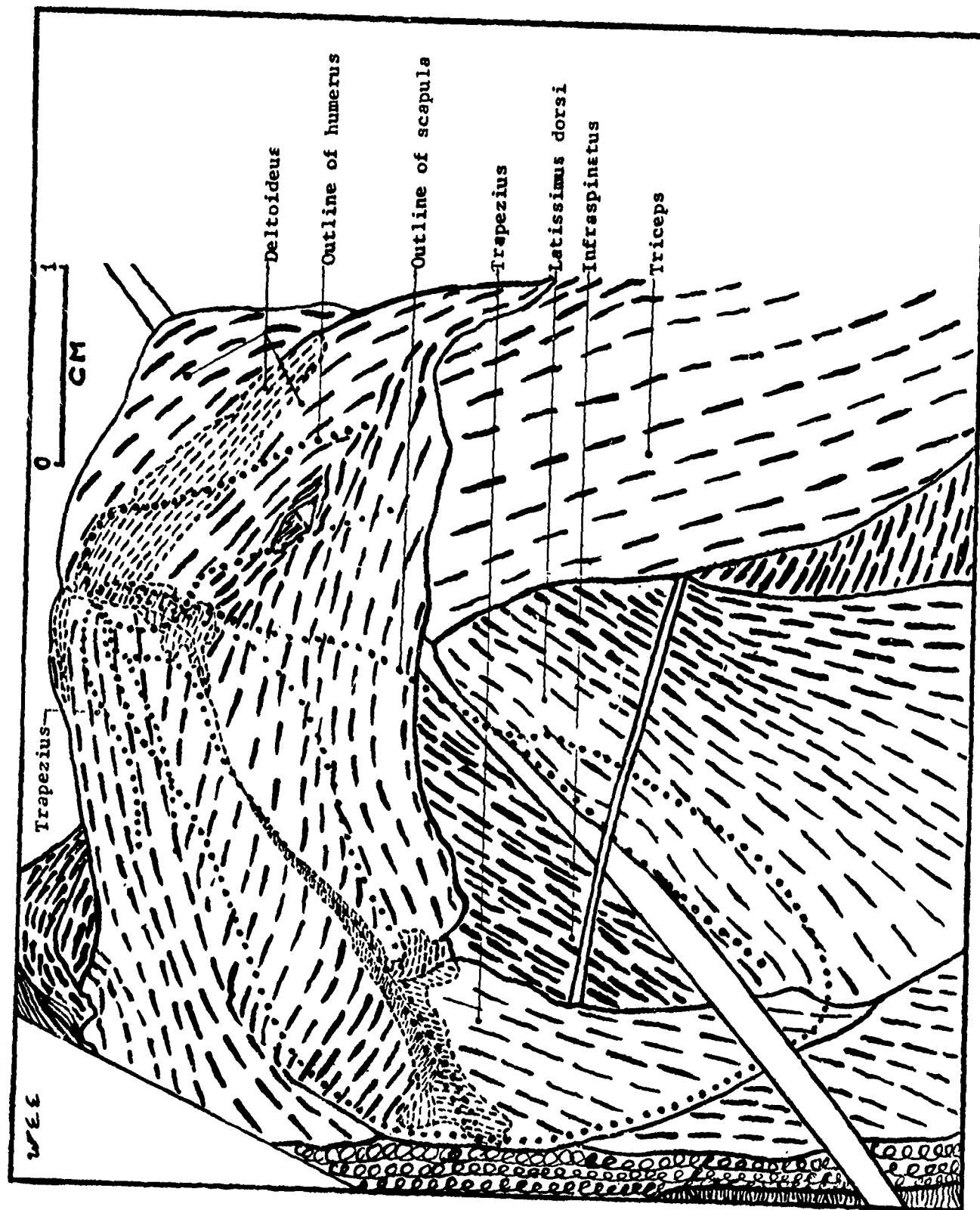


Figure 1
Dorsal View of Back, with Dermis Removed

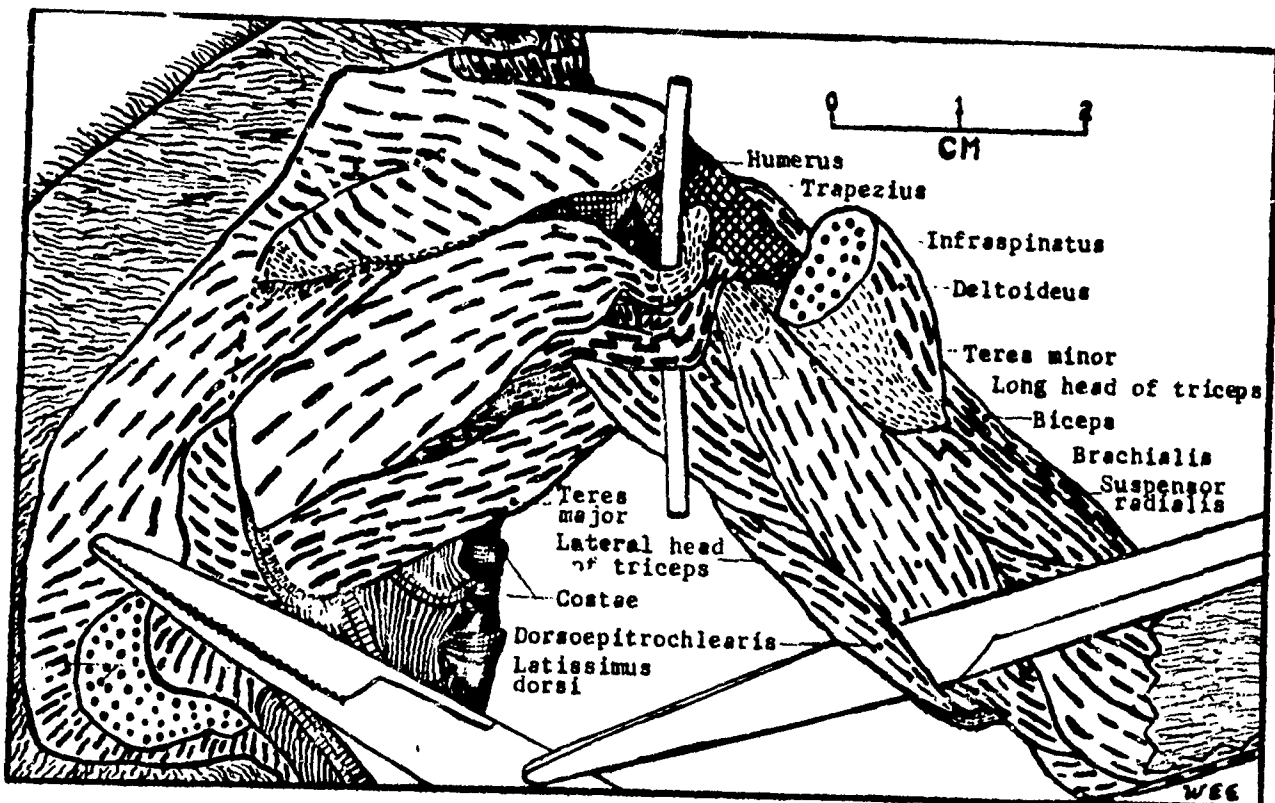


Figure 2

Dorsal View of Right Shoulder and Brachium
With Most of Deltoideus and Latissimus Dorsi Removed

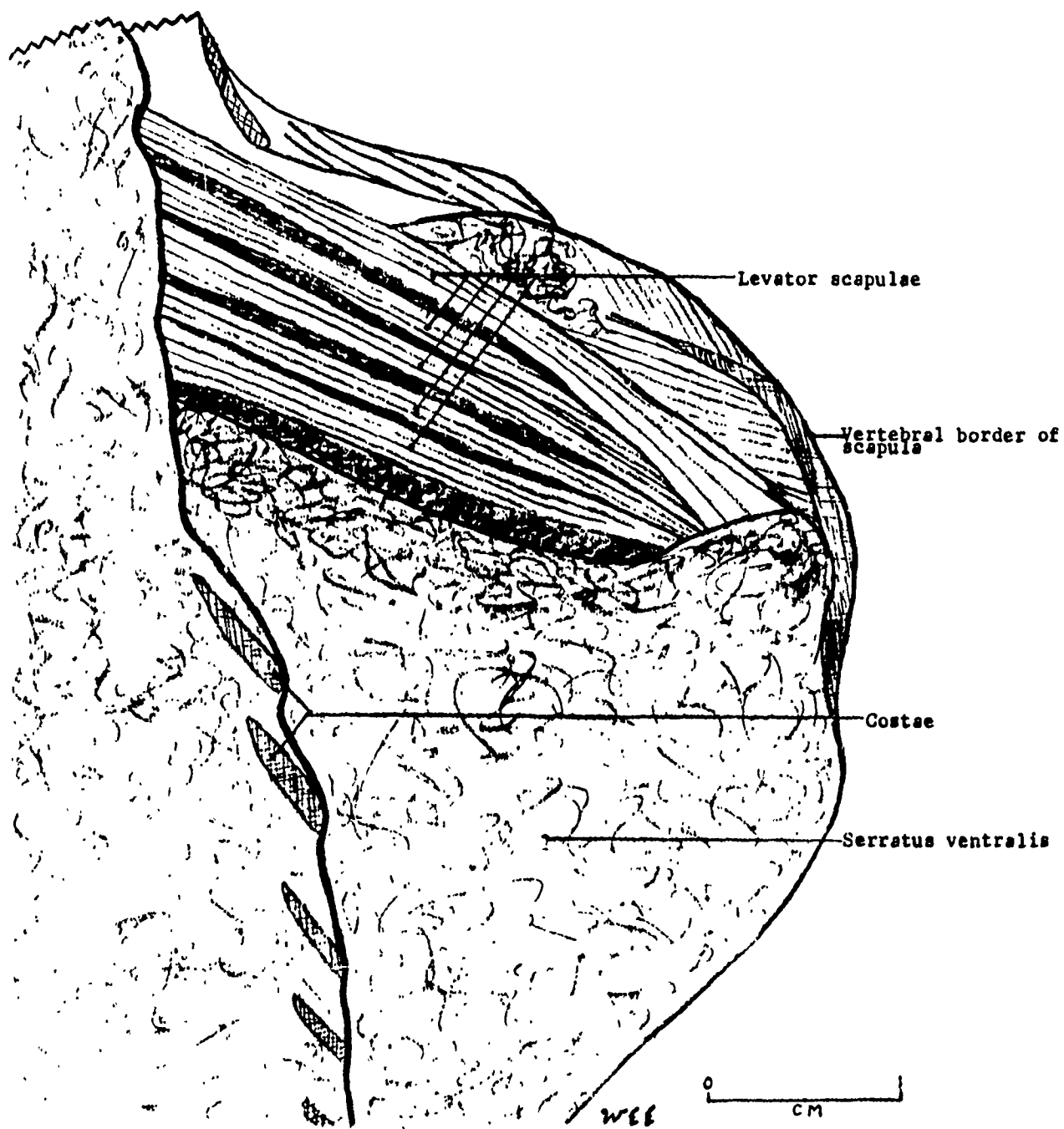


Figure 3
Dorsal View of Thorax, with Scapula Rotated Laterally and Anteriorly

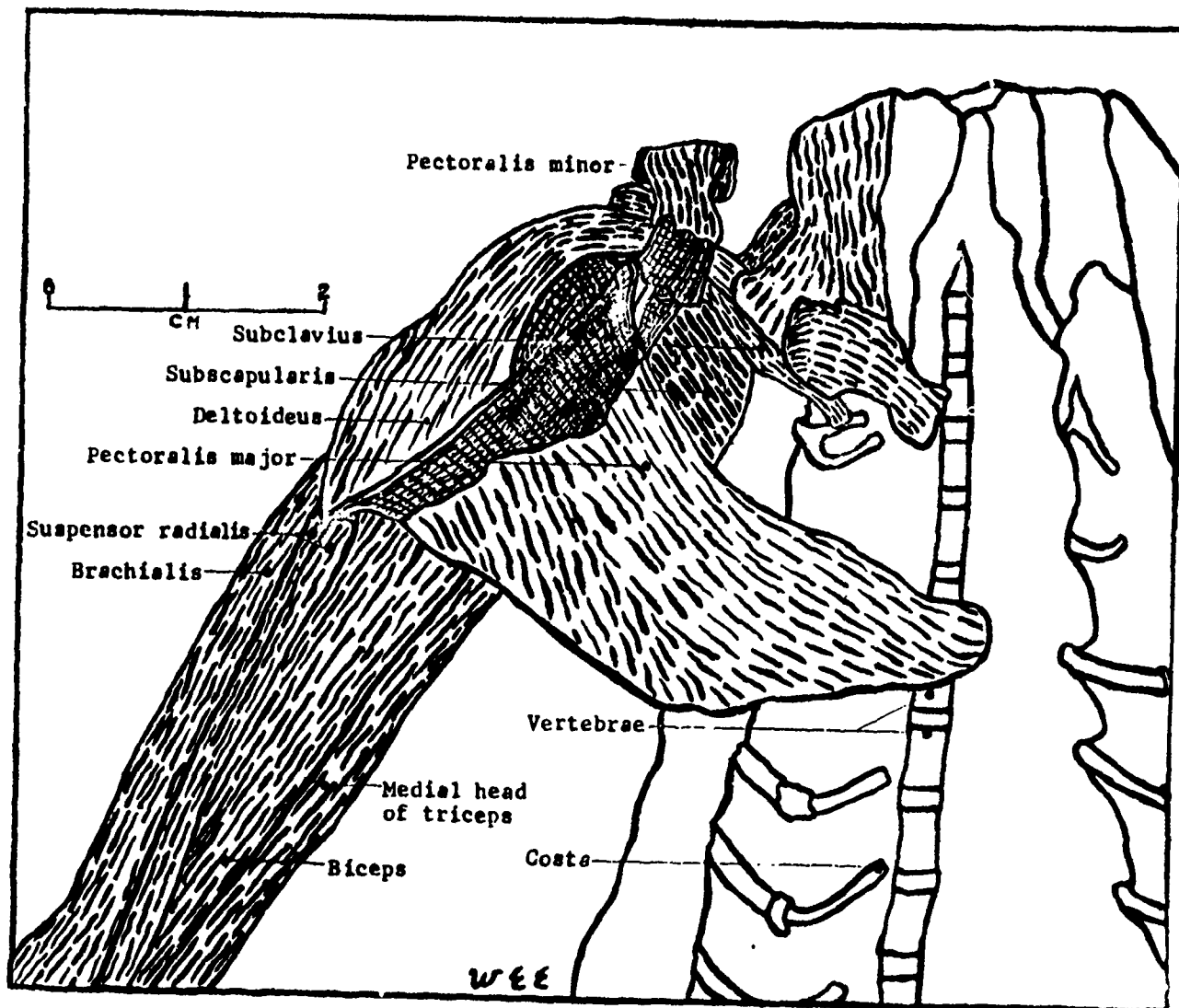


Figure 4

Anterior View of Brachium and Portions of Thorax

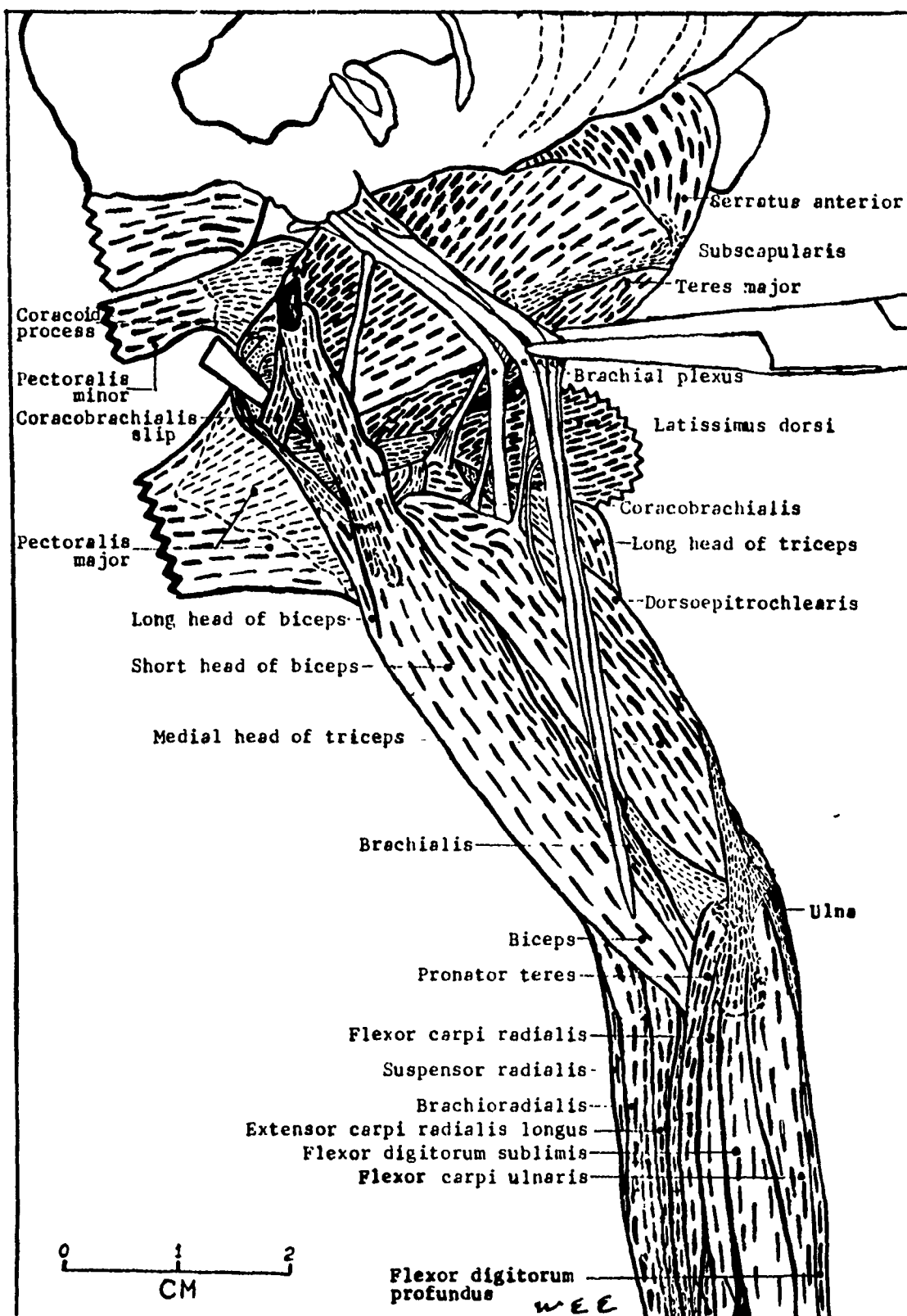


Figure 5

Anterior View of Thorax and Brachium, with Deltoideus Removed
and Pectoralis Major, Pectoralis Minor, and Latissimus Dorsi Transected

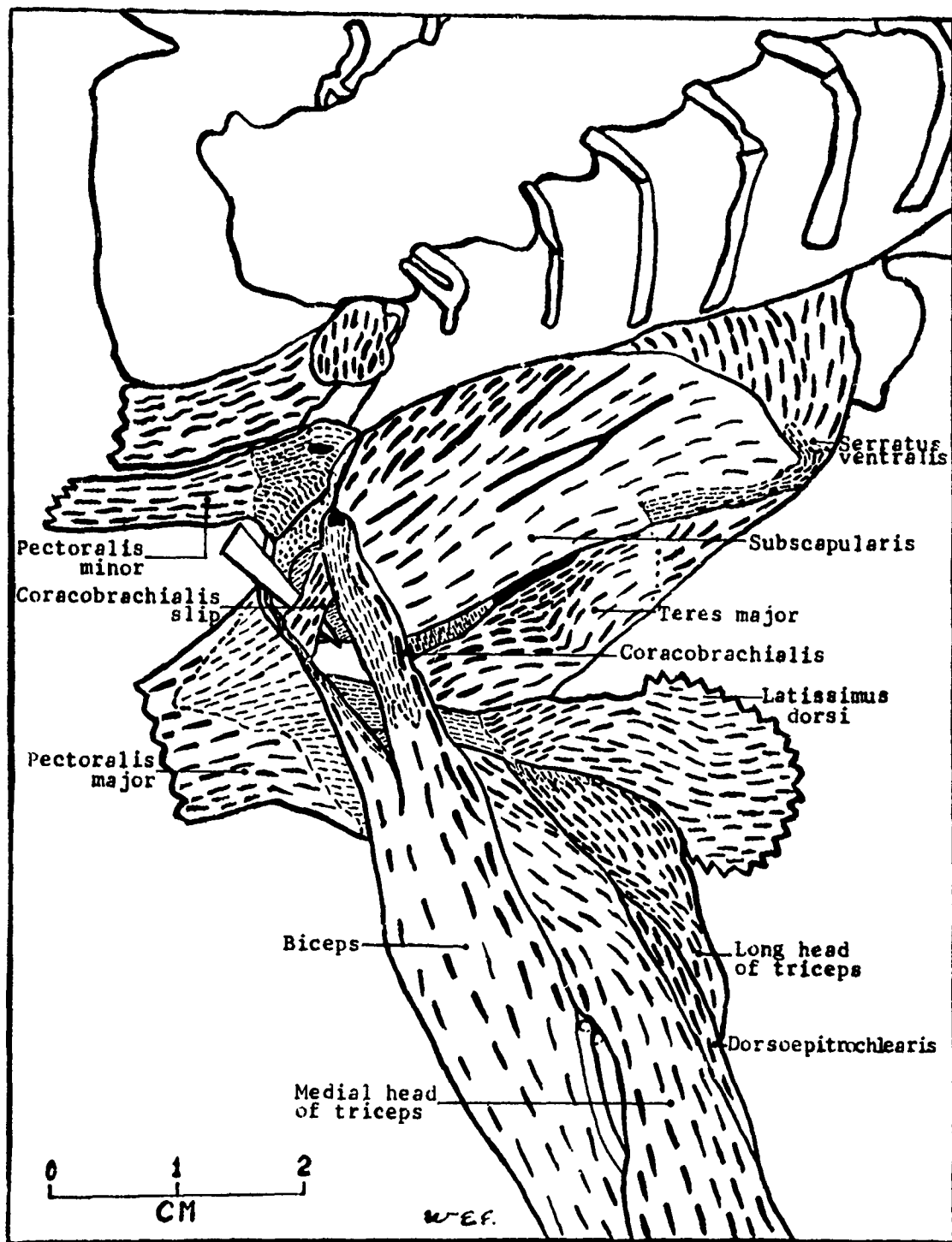


Figure 6
Anterior View of Thorax and Brachium
With Deltoides Removed and Other Muscles Transected

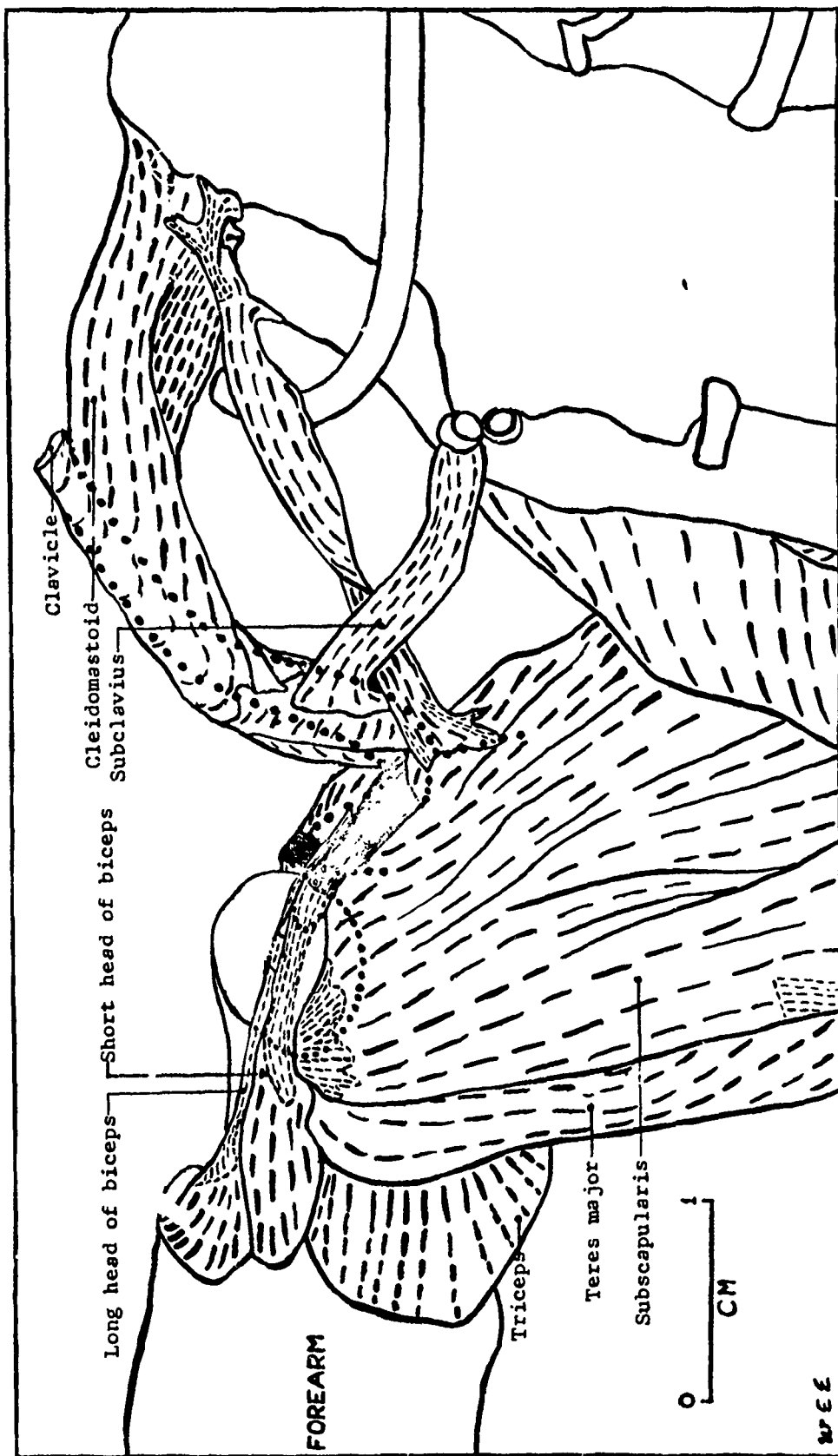


Figure 7

Anterior View of Deeper Layer of Upper Thorax and Shoulder Area

(Teres major and musculature distal to shoulder shown only diagrammatically. Brachium, with axis almost perpendicular to plane of figure, behind shoulder.)

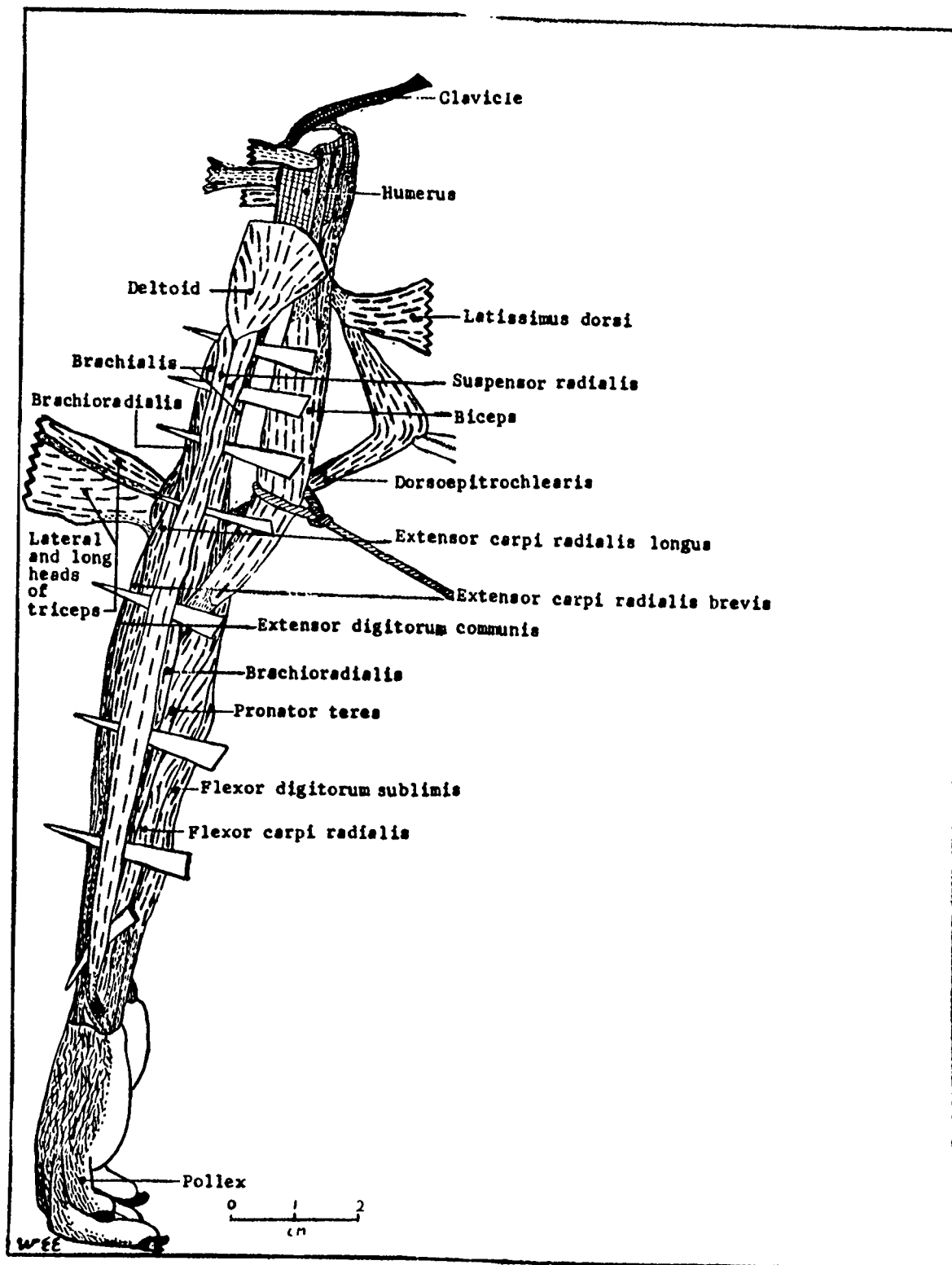


Figure 8
Lateral View of Musculature of Right Upper Extremity
With Portions of Brachial Muscles Removed or Displaced

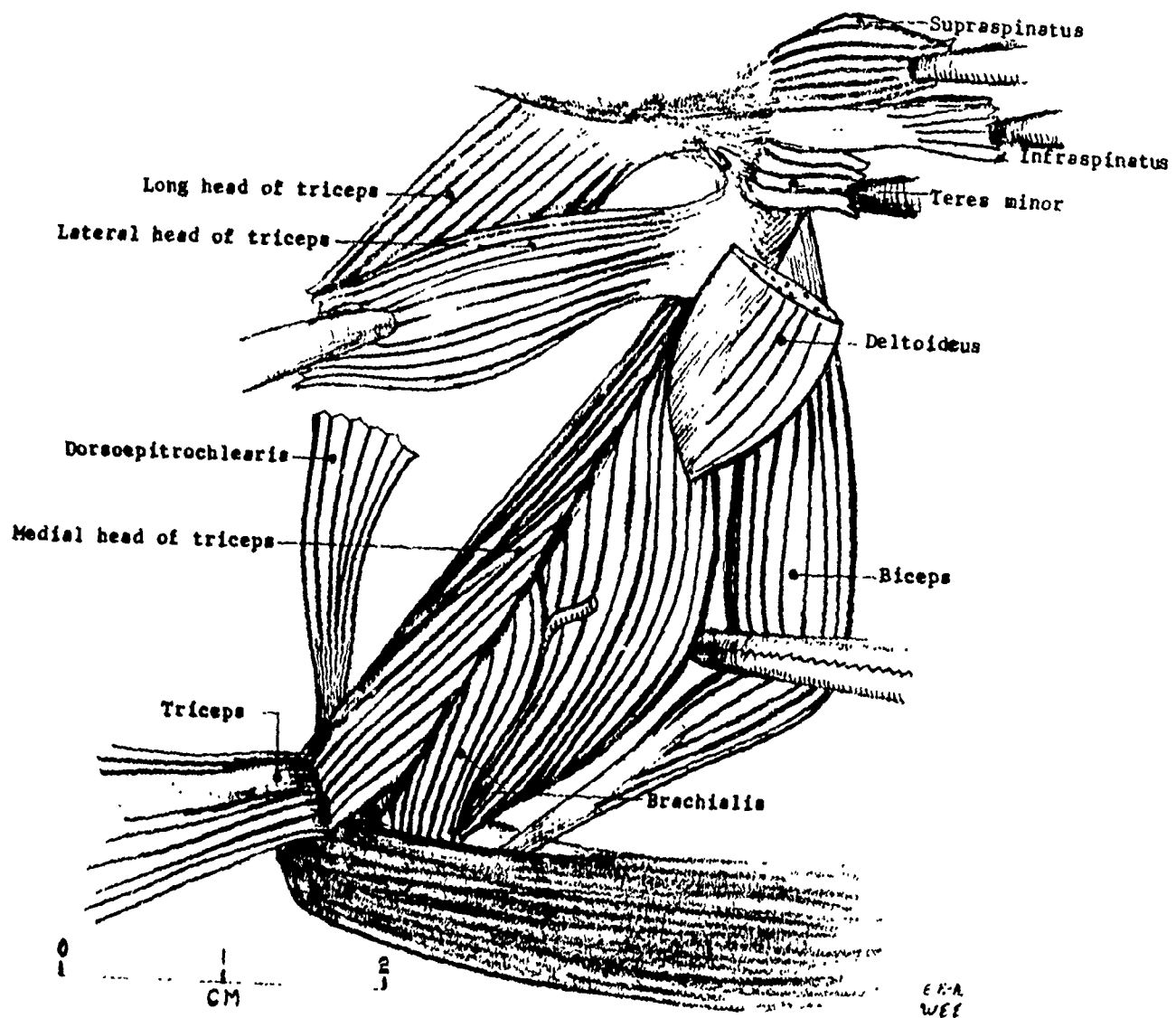


Figure 9

Lateral View of Brachium, with Long and Lateral Heads of Triceps Transected and with Suspensor Radialis, Brachioradialis, and Extensor Carpi Radialis Longus Removed.

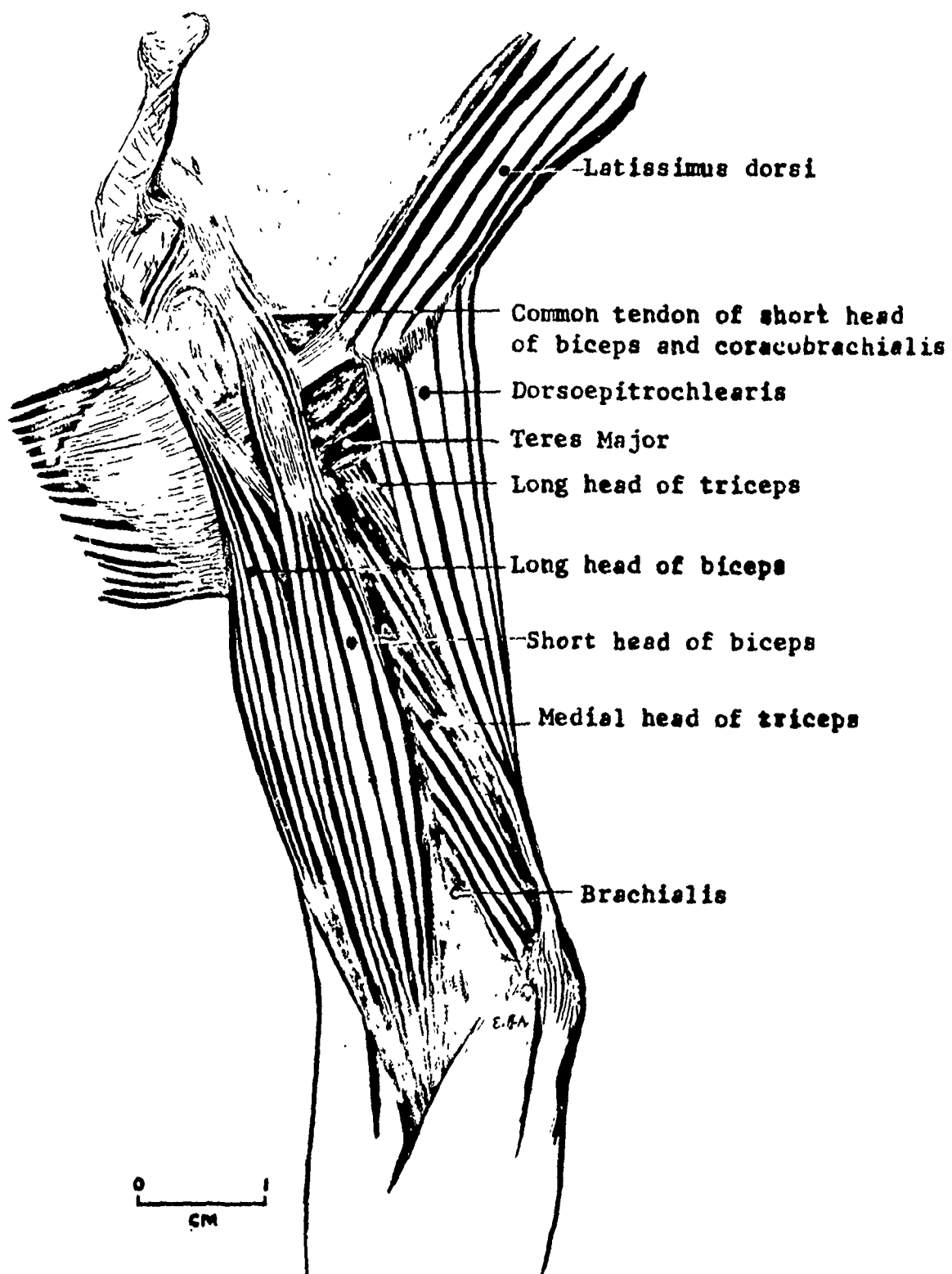


Figure 10
Anteromedial View of Brachium and Axilla.

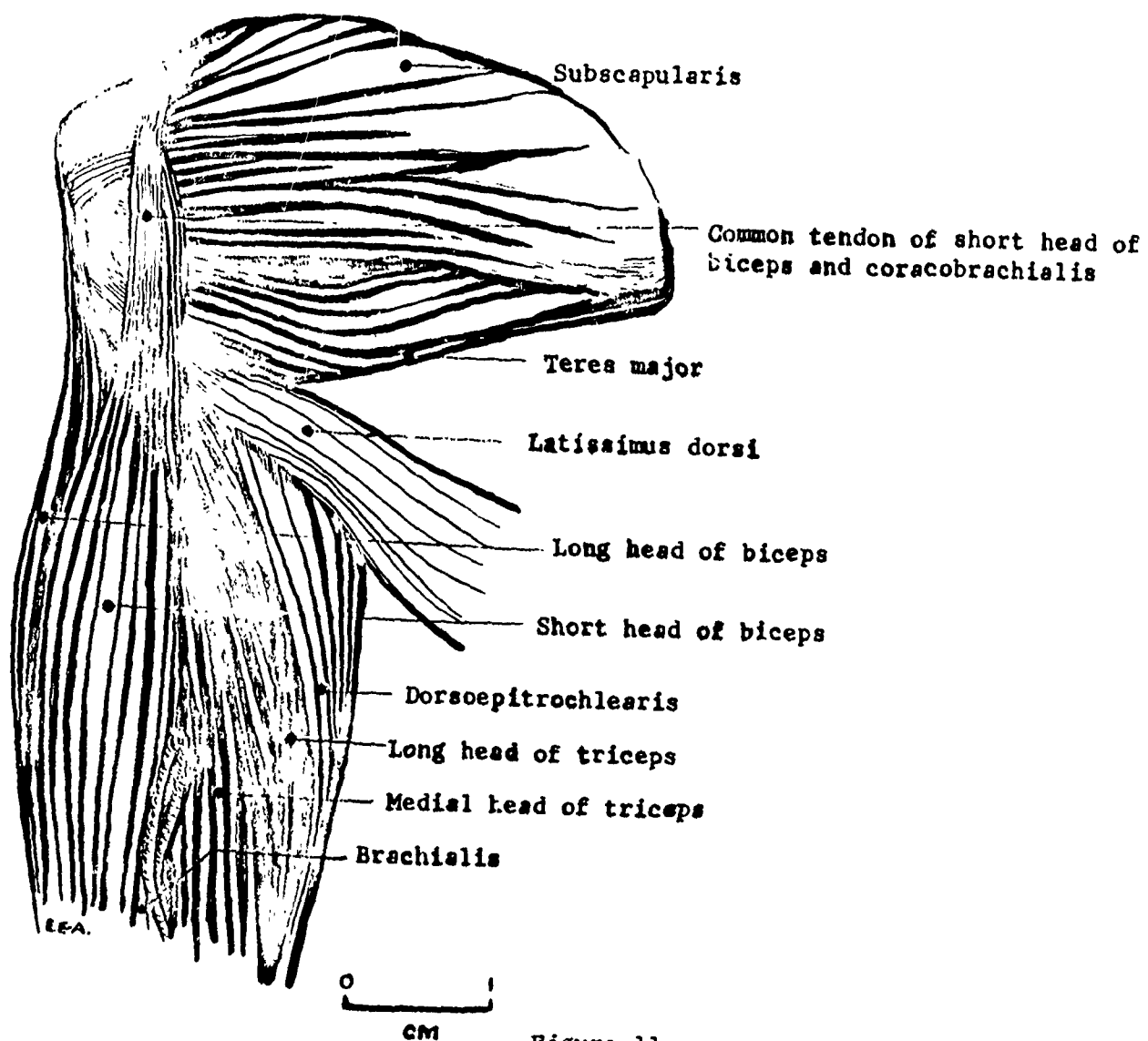


Figure 11

Anterior View of Scapular and Brachial Musculature

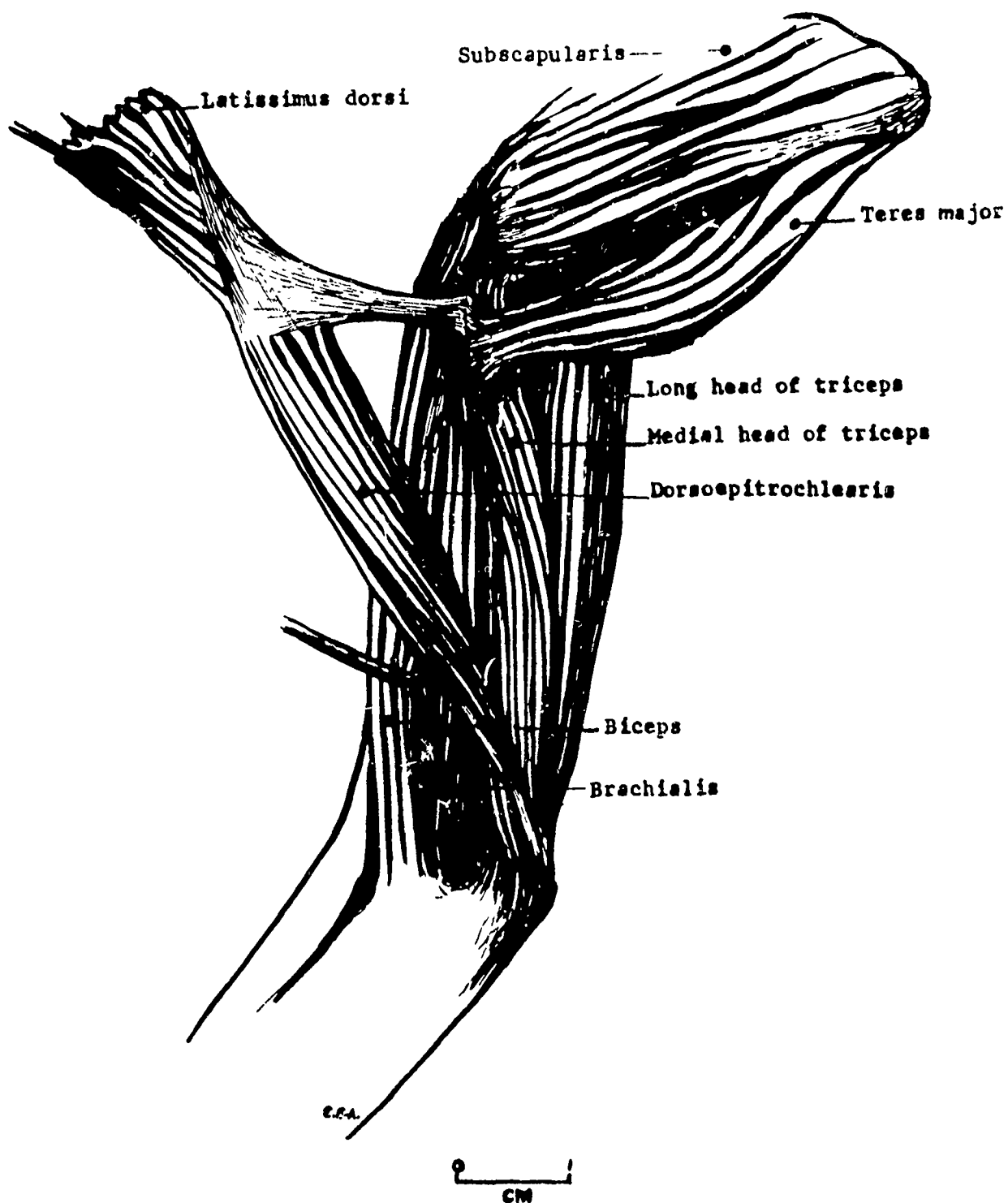


Figure 12

Anterior View of Brachium, with Dorsoepitrochlearis Transposed Laterally

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Security Classification

DOCUMENT CONTROL DATA - R&D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
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3. REPORT TITLE STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY RELATING TO STRENGTH AND ENDURANCE - PHASE VI - THE MUSCULOSKELETAL ANATOMY OF THE THORAX AND BRACHIUM OF A SQUIRREL MONKEY (SAIMIRI)		
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10. AVAILABILITY/LIMITATION NOTICES		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY 6571st Aeromedical Research Laboratory Holloman AFB, New Mexico	
13. ABSTRACT The thoracic and brachial musculature of a female squirrel monkey (<u>Saimiri</u>) is described and illustrated by the photo-etching process. Comparisons with data from the literature on other platyrrhines and a few non-platyrrhine forms are provided.		

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14	KEY WORDS	LINK A		LINK B		LINK C	
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